LECTURE 2

Note Title 1/20/2005

1) Administrivia — new lab sections
— login/password for grades etc
— ~~webct/blackboard~~
— Office Hours start next week

TODAY

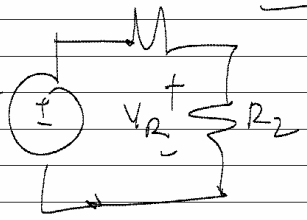
Note Title 1/20/2005

Chapter 1	Chapter 2
1) Idea behind this class	1) Voltage, current source
2) Voltage & Current	2) Ohm's law
3) Ideal basic circuit element	3) Building Circuit Models
4) Power & Energy	4) Kirchoff's laws

Chapter 1 - Idea (goal) of this class (EE 100)

Note Title 1/20/2005

90% [GOAL: CIRCUIT ANALYSIS (NOT DESIGN/SYNTHESIS)

Example: 

Find V_R.

PROBLEM: NONLINEAR → Talk about it later!

Chapter 1 - VOLTAGE & CURRENT

Note Title 1/20/2005

VOLTAGE

Voltage is the separation of energy

units $v \triangleq \frac{dw}{dq}$ $\left(\frac{J}{C}\right)$

"Defined as" Volts

CURRENT

is defined as the flow of positive charge

$i = \frac{dq \to C}{dt \to S}$

units ↓ ampere

VOLTAGE

is like potential energy!

that is, voltage is "across" a battery

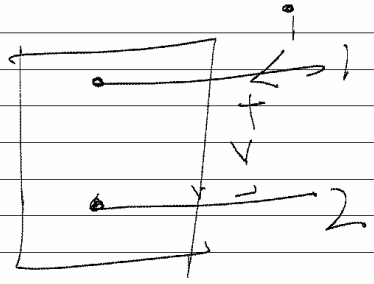
CURRENT

is like water flowing through a pipe

that is, current flowing through a battery.

Chapter 1 - IDEAL BASIC CIRCUIT ELEMENTS

Note Title 1/20/2005



Three properties:

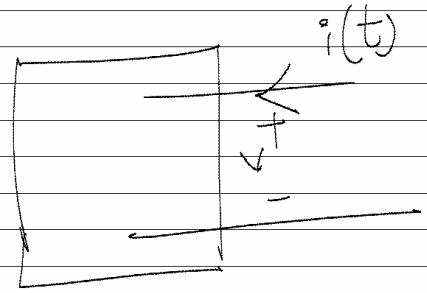
(1) Has only two terminals (for 99% of the class)

(2) has an i-v relationship (some exceptions exist)

(3) Cannot be subdivided further

ASIDE - EXAMPLE: ASSESSING OBJECTIVE 2

(1.3)



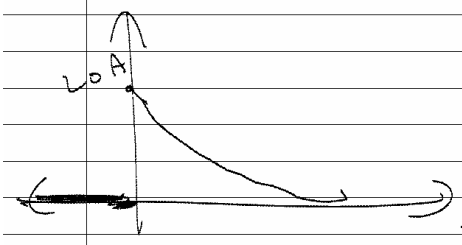
$i(t) = 0 \quad t < 0$

$= 20e^{-5000t}\ A \quad t \geq 0$

Question: Calculate total charge (in μC) entering the element...

Note Title 1/20/2005

EXAMPLE 1 (cont'd).



$i(t)$, $t \geq 0$ is $20e^{-5000t}$ A

$i \triangleq \frac{dq}{dt}$

$t \to \infty$

$\Rightarrow q = \int_{t=0}^{t\to\infty} i\,dt$

Note: $t \to \infty$ because you want total charge

$$= \int_0^{\infty} 20 e^{-5000t}\, dt$$

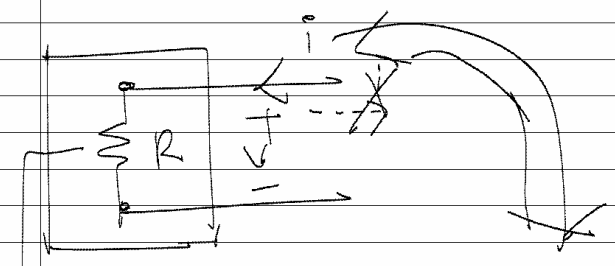
$$= \frac{20 e^{-5000t}}{-5000}\Bigg|_{t=0}^{t\to\infty}$$

$$= 20 \cdot \frac{1}{5000} = \frac{4}{1000} C = \frac{4000}{10^{-6}} C$$

$$= 4000\ \mu C$$

Note Title 1/20/2005

Chapter 1 - POWER & SIGN CONVENTION

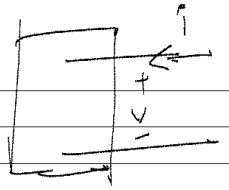


Symbol for a resistor:

SIGN CONVENTION

$v = iR$: Ohm's LAW

R: Resistance; Unit: Ohm (Ω)

Why  is positive convention?

Answer: Because of power

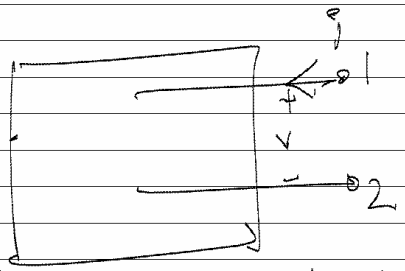
$$\text{power} = \frac{dw}{dt} = \frac{dw}{dq} \cdot \frac{dq}{dt} \quad \left[\text{Chain Rule}\right]$$

$$\boxed{p = V \cdot I} \text{ Watts}$$

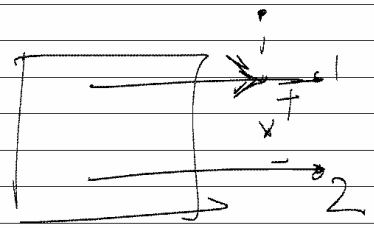
SIGN CONVENTION

Note Title 1/20/2005

We need to distinguish between power absorbed & power released!



1) Device is absorbing energy



2) Device is releasing energy

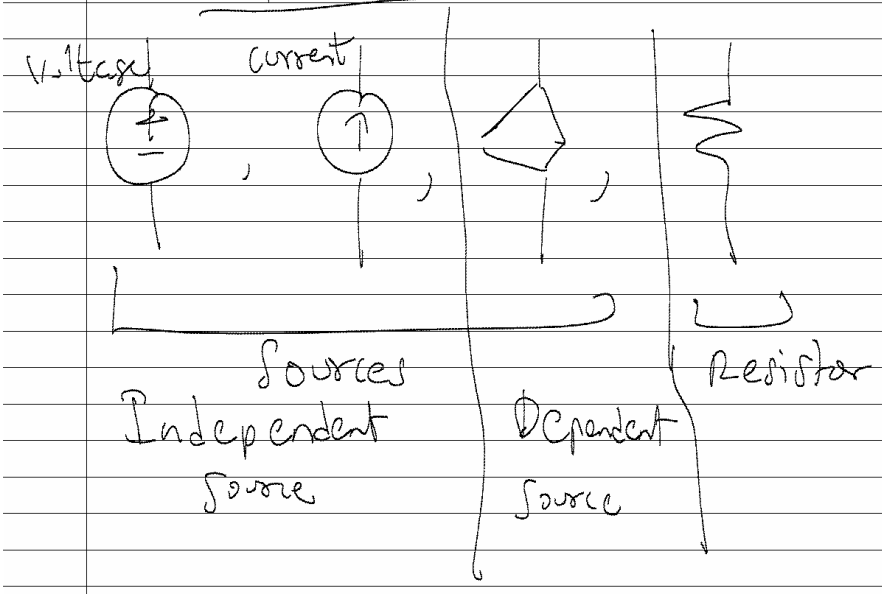
because charges are flowing from + to − ⇒ higher potential to lower potential. Lost energy is going into device!

$p = vi$ watts

$p = -vi$ watts

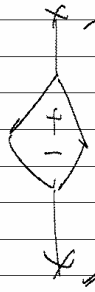
Chapter 2 – Circuit Elements

Note Title 1/20/2005



Dependent Voltage Sources

Note Title 1/20/2005



Example:

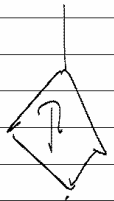
If $V_b = 4V$,

$v = 20\ V$

Voltage elsewhere in the circuit

Similarly, we have current sources

Independent current source

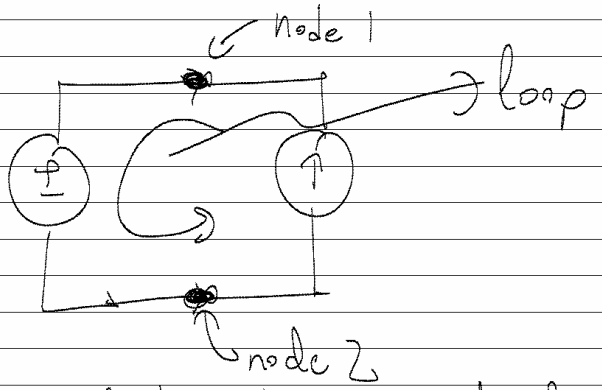


Dependent current source

Circuit Terminology

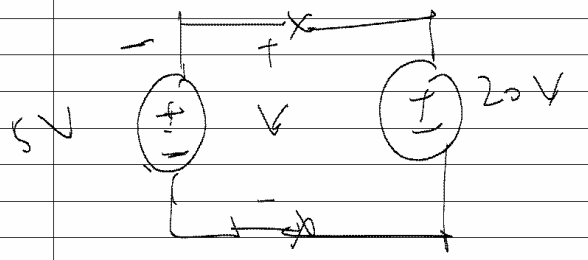
Note Title 1/20/2005

Node: point where two circuit elements meet



loop: If you start at one node & trace a path back to the same node

Examples of circuit

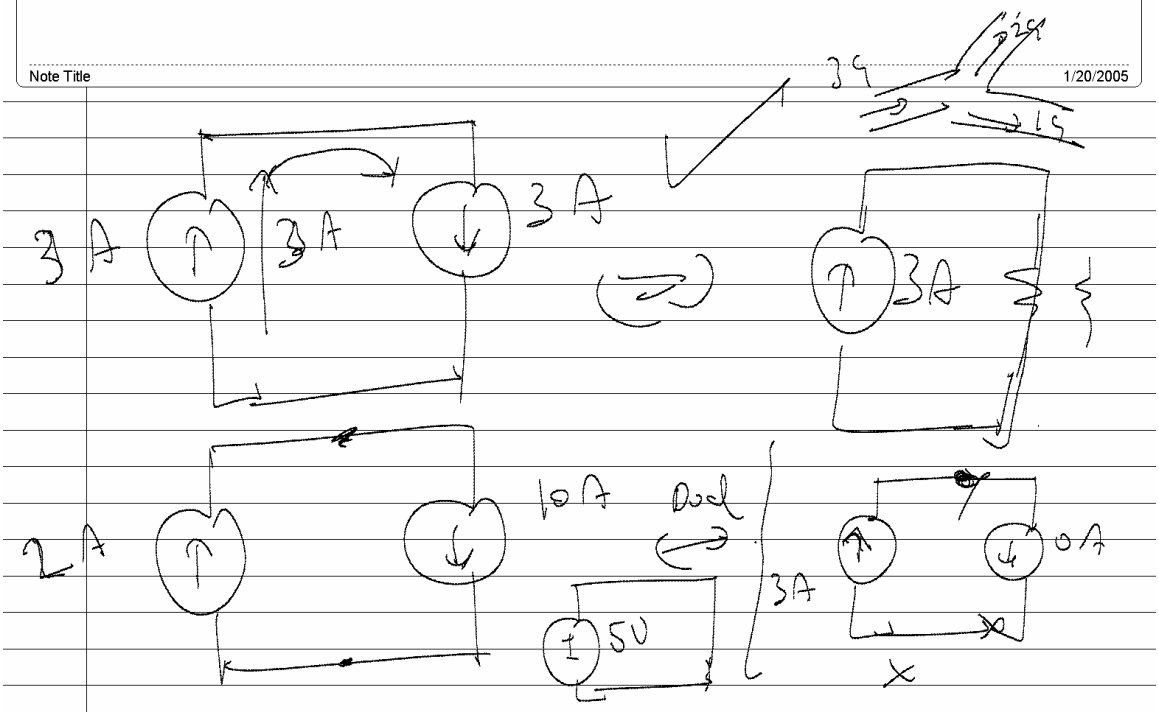


Circuits ordered

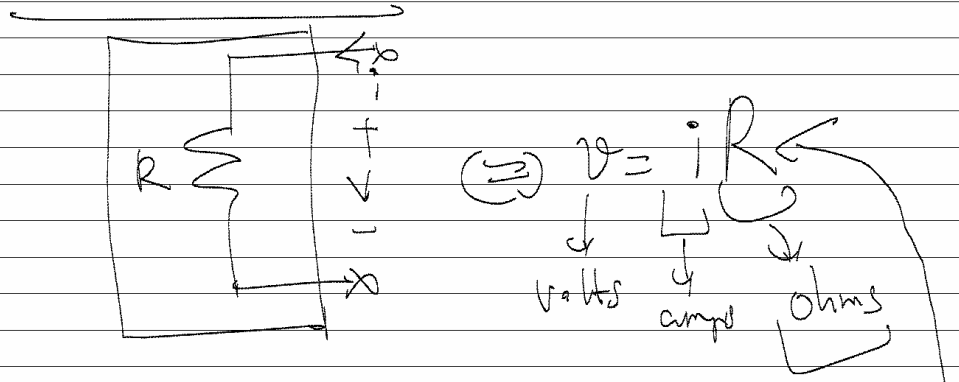
$V = 5V \qquad V = 20V$

$20 = 5$

Note Title 1/20/2005



OHm's LAW : describes a resistor.



Notes: $x^2 + y^2 = 1$ ⇒ circle